Subject Index

A
AAL-toxins
  host-selective toxins and avirulence determinants, 251–52
Acacia spp.
  evolutionary ecology of plant diseases in natural ecosystems and, 17
  phytochemical-based strategies for nematode control and, 226
Acquired resistance
  antibiotic use in plant agriculture and, 445
Activation
  viral sequences integrated into plant genomes and, 117, 131
Acytokinetic mitosis
  gene expression in nematode feeding sites and, 195–96, 200
Adhesins
  comparative genomic analysis of plant-associated bacteria and, 166, 176, 178–79
Aecidium faeamae
  evolutionary ecology of plant diseases in natural ecosystems and, 18
Aegelops spp.
  stripe rust of wheat and barley in North America and, 81–82, 85, 96
Aggressiveness
  stripe rust of wheat and barley in North America and, 93–96
Agriculture
  multiline cultivars and cultivar mixtures, 373–93
  risk assessment of virus-resistant transgenic plants and, 457–74
  specific soil suppressiveness and, 302–27
Agrobacterium radiobacter
  biological control of postharvest diseases of fruits and, 406
Agrobacterium rhizogenes
  phytochemical-based strategies for nematode control and, 230
Agrobacterium tumefaciens
  biological control of postharvest diseases of fruits and, 406
  comparative genomic analysis of plant-associated bacteria and, 166–83
  gene expression in nematode feeding sites and, 194, 197
  Phytophthora-host recognition and, 147
Agronomics
  multiline cultivars and cultivar mixtures, 373
  stripe rust of wheat and barley in North America and, 76, 78, 80, 84–85
  virus vectors and agriculture, 57–58
Albizia chinensis
  phytochemical-based strategies for nematode control and, 226
Albugo candida
  evolutionary ecology of plant diseases in natural ecosystems and, 16
Alfalfa mosaic virus
  risk assessment of virus-resistant transgenic plants and, 463
  virus vectors and agriculture, 45
Alfamovirus
  virus vectors and agriculture, 46, 51
Algae
  phytochemical-based strategies for nematode control and, 231
Alkaloids
  phytochemical-based strategies for nematode control and, 216, 223
Allies/enemies
  virus vectors and agriculture, 43–65
Allium spp.
  phytochemical-based strategies for nematode control and, 224, 230
Alternaria alternata
  host-selective toxins and avirulence determinants, 258–60
Ammophila spp.
  evolutionary ecology of plant diseases in natural ecosystems and, 22
Amphicarpaea bracteata
  evolutionary ecology of plant diseases in natural ecosystems and, 31
Amplified ribosomal DNA

restriction analyses (ARDRA)
specific soil suppressiveness and, 320, 322
Amplified ribosomal intergenic spacer analysis (ARISA)
specific soil suppressiveness and, 320
Andropogon gerardii
evolutionary ecology of plant diseases in natural ecosystems and, 21
Angelica pubescens
phytochemical-based strategies for nematode control and, 223
Anguina tritici
phytochemical-based strategies for nematode control and, 219
Anthoxanthum spp.
evolutionary ecology of plant diseases in natural ecosystems and, 22
Anthurium spp.
phytochemical-based strategies for nematode control and, 218
Antibiotics
use in plant agriculture and
acquisition of streptomycin-resistance genes, 444–45
amounts of antibiotics used, 437–39
antibiotics used on plants, 435–37
apple production, 449–50
conclusions, 451
controversy, 447–49
ecology of antibiotic resistance determinants, 444–47
Erwinia amylovora, 440–42
fire blight, 450–51
future without antibiotics, 449–51
genetics of resistance, 440
gentamicin, 436–37
horizontal transfer of streptomycin-resistance determinants among diverse bacteria, 445–47
introduction, 434–35
mutation-determined resistance, 440–41
oxolinic acid, 437
oxytetracycline, 436
pear production, 449–50
persistence, 443
plasmid/transposon-determined resistance, 441–42
Pseudomonas spp., 442–43
regulation, 439
streptomycin, 436
streptomycin-resistant plant pathogens, 439–45
tetracycline-resistant bacteria in orchards, 443–44
tree-fruit crops, 437–9
Xanthomonas campestris, 442–43
Aphanomyces spp.
Phytophthora-host recognition and, 138
specific soil suppressiveness and, 303
Aphelenchoides besseyi
phytochemical-based strategies for nematode control and, 226
APHIS
virus vectors and agriculture, 62–63
Apium graveolens
phytochemical-based strategies for nematode control and, 228
Apparent competition
evolutionary ecology of plant diseases in natural ecosystems and, 21–22
Apple production
antibiotic use in plant agriculture and, 449–50
Apple replant disease
specific soil suppressiveness and, 302, 309–10
Arabica spp.
multiline cultivars and cultivar mixtures, 382
Arabidopsis thaliana
comparative genomic analysis of plant-associated bacteria and, 176
gene expression in nematode feeding sites and, 194, 198, 200–1
Phytophthora-host recognition and, 147, 151, 155
viral sequences integrated into plant genomes and, 121
virus vectors and agriculture, 48, 53
Arabis spp.
evolutionary ecology of plant diseases in natural ecosystems and, 18
Arachis hypogaea
phytochemical-based strategies for nematode control and, 224
Arceuthobium spp.
evolutionary ecology of plant diseases in natural ecosystems and, 17

Argemone mexicana
phytochemical-based strategies for nematode control and, 224
Armillaria spp.
evolutionary ecology of plant diseases in natural ecosystems and, 18, 30
Arthrobotrys spp.
phytochemical-based strategies for nematode control and, 231
Ascophyllum nodosum
phytochemical-based strategies for nematode control and, 231
Asexual reproduction
durable resistance and, 342–65
Asparagus spp.
phytochemical-based strategies for nematode control and, 226, 229
Aspergillus spp.
phytochemical-based strategies for nematode control and, 232–33
Asteraceae
phytochemical-based strategies for nematode control and, 222–23
Aureobasidum pullulans
biological control of postharvest diseases of fruits and, 408, 410, 415–16
Autoinfection/alloinfection ratio
multiline cultivars and cultivar mixtures, 380
Avena sativa
multiline cultivars and cultivar mixtures, 383
Avirulence determinants
host-selective toxins and, 245–65
Avr genes
comparative genomic analysis of plant-associated bacteria and, 176
durable resistance and, 347, 349
host-selective toxins and avirulence determinants, 245–65
Phytophthora-host recognition and, 151–55
Azadirachta indica
phytochemical-based strategies for nematode control and, 227

B

Bacillus halodurans
Phytophthora-host recognition and, 151
Bacillus spp.
biological control of postharvest diseases of fruits and, 405–6, 408, 412, 416–17, 421
Phytophthora-host recognition and, 151
risk assessment of virus-resistant transgenic plants and, 466
Bacopa monniera
phytochemical-based strategies for nematode control and, 226
Bacteria
antibiotic use in plant agriculture and, 434–51
comparative genomic analysis of plant-associated bacteria and, 166–83
Banana streak virus
viral sequences integrated into plant genomes and, 117, 123–25
bar gene
virus vectors and agriculture, 48–49, 53
Barley
durable resistance and, 361
stripe rust of in North America, 73–107
Barley stripe mosaic virus
virus vectors and agriculture, 45, 52
Beauveria bassiana
phytochemical-based strategies for nematode control and, 232
Beet necrotic yellow vein virus
risk assessment of virus-resistant transgenic plants and, 467
Beet yellow virus
virus vectors and agriculture, 45
Beta vulgaris
gene expression in nematode feeding sites and, 198
multiline cultivars and cultivar mixtures, 384
phytochemical-based strategies for nematode control and, 218
risk assessment of virus-resistant transgenic plants and, 467
Biological buffering
specific soil suppressiveness and, 304
Biological containment and safety
virus vectors and agriculture, 62–64
Biological control
phytochemical-based strategies for nematode control and, 216–35
specific soil suppressiveness and, 302–27

Biological control of postharvest diseases (BCPD)
fruits and
antagonist, 407–9
applying mixed cultures, 412–13
developing commercial product, 420–21
enhancement of biocontrol, 411–20
future research, 421–22
genetic manipulations, 414
integration with other methods, 417–20
introduction, 403–4
manipulation of environment, 412
manipulation of formulations, 416–17
mechanisms of biocontrol, 409–11
pathogens, 406–7
physiological manipulations, 414
preharvest applications, 415–16
uniqueness, 404–6
Bioreactors
virus vectors and agriculture, 44, 54
Biosafety
risk assessment of virus-resistant transgenic plants and, 457
viral sequences integrated into plant genomes and, 131–32
Biotechnology
gene expression in nematode feeding sites and, 205–6
Biotrophs
gene expression in nematode feeding sites and, 187–206
Bipolaris spp.
host-selective toxins and avirulence determinants, 260
phytochemical-based strategies for nematode control and, 232
BLASTP program
comparative genomic analysis of plant-associated bacteria and, 181
Blumeria graminis
durable resistance and, 352, 355, 361–62
multiline cultivars and cultivar mixtures, 374–75, 385–88
Bocconia cordata
phytochemical-based strategies for nematode control and, 223
Boom-and-bust cycles
durable resistance and, 343–44, 348
multiline cultivars and cultivar mixtures, 374
Bordetella pertussis
comparative genomic analysis of plant-associated bacteria and, 176, 178–79
Botryosphaeria dothidea
evolutionary ecology of plant diseases in natural ecosystems and, 25
Botrytis cinerea
biological control of postharvest diseases of fruits and, 405, 406, 409–11, 417
Brassica spp.
phytochemical-based strategies for nematode control and, 221–22, 226, 228
risk assessment of virus-resistant transgenic plants and, 468
Breeding for resistance
stripe rust of wheat and barley in North America and, 82–83, 104–5
Breeding programs
durable resistance and, 361–64
Bremia lactucae
durable resistance and, 355
Brome mosaic virus
risk assessment of virus-resistant transgenic plants and, 471
virus vectors and agriculture, 45
Bromovirus
virus vectors and agriculture, 46
Bromus spp.
stripe rust of wheat and barley in North America and, 74–75, 77–79, 85
Brucella suis
comparative genomic analysis of plant-associated bacteria and, 176
Brugia pahangi
phytochemical-based strategies for nematode control and, 227
Bupleurum salicifolium
phytochemical-based strategies for nematode control and, 229
Bursaphelenchus xylophilus
phytochemical-based strategies for nematode control and, 223
Butt rot
evolutionary ecology of plant diseases in natural ecosystems and, 17–18

C
Caenorhabditis elegans
phytochemical-based strategies for nematode control and, 219, 221, 223, 227–32, 235
Callistemon lanceolatus
phytochemical-based strategies for nematode control and, 224
Calocybe monarius
phytochemical-based strategies for nematode control and, 232
Canavalaria spp.
phytochemical-based strategies for nematode control and, 230
Candida spp.
biological control of postharvest diseases of fruits and, 411–12, 414–16, 418, 421
Cankers
evolutionary ecology of plant diseases in natural ecosystems and, 17
Capsella bursa-pastoris
evolutionary ecology of plant diseases in natural ecosystems and, 16
Capsid proteins
virus vectors and agriculture, 43–65
Carboxin
history of research, 4–5
Carthamus tinctorius
phytochemical-based strategies for nematode control and, 222
Carum carvi
phytochemical-based strategies for nematode control and, 225
Catharanthus roseus
phytochemical-based strategies for nematode control and, 223
Cauliflower mosaic virus
gene expression in nematode feeding sites and, 198
risk assessment of virus-resistant transgenic plants and, 470–72
Caulobacter crescentus
comparative genomic analysis of plant-associated bacteria and, 178, 181
Cause and effect
gene expression in nematode feeding sites and, 195–97
Cell differentiation
gene expression in nematode feeding sites and, 199–203
Cell wall-degrading enzymes
comparative genomic analysis of plant-associated bacteria and, 176–77
Cell wall fragments
Phytophthora-host recognition and, 144–45
Cephalobus spp.
phytochemical-based strategies for nematode control and, 224
Cephalosporium gramineum
history of research, 5
multiline cultivars and cultivar mixtures, 385
Cephalosporium stripe
history of research, 1, 5
Ceratocystis spp.
history of research, 3
Cercospora spp.
biological control of postharvest diseases of fruits and, 421
Chaetomium globosum
phytochemical-based strategies for nematode control and, 233
Chamaecrista fasciculata
evolutionary ecology of plant diseases in natural ecosystems and, 21
Chamaecyparis lawsoniana
evolutionary ecology of plant diseases in natural ecosystems and, 17
Cheionophyllum candidissimum
phytochemical-based strategies for nematode control and, 232
Chemical control
stripe rust of wheat and barley in North America and, 105–6
Chemotaxis
Phytophthora-host recognition and, 135, 137–39
Chemotropism
Phytophthora-host recognition and, 141–42
Chlorosis
tobacco mosaic virus assembly and disassembly, 280, 289–90
Chlorosplenium sp.
phytochemical-based strategies for nematode control and, 232
Chondrilla juncea
evolutionary ecology of plant diseases in natural ecosystems and, 21, 27
Cinchona robusta
Phytophthora-host recognition and, 144
Cirsium japonicum
phytochemical-based strategies for nematode control and, 222
Cladobotyrum rubrobrunnescens

phytochemical-based strategies for nematode control and, 232
Cladosporium fulvum
durable resistance and, 355
Claviceps purpurea
history of research, 6
Climate changes
stripe rust of wheat and barley in North America and, 91–92
Clostrovirus
virus vectors and agriculture, 46
Clover yellow vein virus
virus vectors and agriculture, 45, 48
Coat proteins
tobacco mosaic virus assembly and disassembly, 280–96
Cochliobolus spp.
host-selective toxins and avirulence determinants, 260–62
phytochemical-based strategies for nematode control and, 232
Cold War research
stripe rust of wheat and barley in North America and, 84
Colletotrichum spp.
biological control of postharvest diseases of fruits and, 405–6
durable resistance and, 355
multiline cultivars and cultivar mixtures, 381
Colony hybridization
specific soil suppressiveness and, 318
Commercial product development
biological control of postharvest diseases of fruits and, 420–21
virus vectors and agriculture, 47–53
Comovirus
virus vectors and agriculture, 46
Comparative genomic analysis
plant-associated bacteria and
bacterial adhesion, 178–79
bacterial encoded phytohormones, 180–81
cell wall-degrading enzymes, 176–77
conclusions, 182–83
DNA exchange mechanisms, 171
DNA metabolism, 173–74
general metabolism, 171–73
genes shared between all eight genomes, 181–82
host-bacteria interactions, 174–81
introduction, 167–69
oxidative stress, 179–80
pathogenicity, 174–81
secretion systems, 175–76
structural comparisons between genomes, 169–71
surface structural elements, 178–79
toxins, 177–78
Compatibility
host-selective toxins and avirulence determinants, 245–46, 256–58
Competition
evolutionary ecology of plant diseases in natural ecosystems and, 12, 20–27
specific soil suppressiveness and, 324–26
Complementation
risk assessment of virus-resistant transgenic plants and, 461–64
Control
stripe rust of wheat and barley in North America and, 73–107
Coreopsis lanceolata
phytochemical-based strategies for nematode control and, 222
Cotton leaf curl virus
viral sequences integrated into plant genomes and, 129
Counterweights
to numerical effects
evolutionary ecology of plant diseases in natural ecosystems and, 20
Cowpea chlorotic mottle virus
risk assessment of virus-resistant transgenic plants and, 470
Cowpea mosaic virus
virus vectors and agriculture, 45, 50–51, 54, 64
Craterostigma plantagineum
gene expression in nematode feeding sites and, 194
Criconomella xenoplax
specific soil suppressiveness and, 303
Cross-protection
tobacco mosaic virus assembly and disassembly, 280, 293–95
Crotalaria spectabilis
phytochemical-based

strategies for nematode control and, 223
crtB gene
virus vectors and agriculture, 53
Cryphonectria parasitica
evolutionary ecology of plant diseases in natural ecosystems and, 30
Cryptococcus spp.
biological control of postharvest diseases of fruits and, 415
Cucumber mosaic virus
evolutionary ecology of plant diseases in natural ecosystems and, 20
risk assessment of virus-resistant transgenic plants and, 460, 464–65
Cucumis sativus
phytochemical-based strategies for nematode control and, 227
Cucurbit aphid-borne yellows virus
risk assessment of virus-resistant transgenic plants and, 469
Cultivar resistance
stripe rust of wheat and barley in North America and, 75–77
Curcuma comosa
phytochemical-based strategies for nematode control and, 228
Cyanogenic glycosides
phytochemical-based strategies for nematode control and, 216, 222
Cylindrocarpon olidum
phytochemical-based strategies for nematode control and, 233
Cymbopogon caesius
phytochemical-based strategies for nematode control and, 225

D

Dactylis glomerata
stripe rust of wheat and barley in North America and, 73
Daldinia concentrica
phytochemical-based strategies for nematode control and, 232
Danthonia spp.
evolutionary ecology of plant diseases in natural ecosystems and, 22
Daphne odora
phytochemical-based strategies for nematode control and, 226
Debaromyces hansenii
biological control of postharvest diseases of fruits and, 421
Decay
biological control of postharvest diseases of fruits and, 403–23
Decision diagram
to aid resistance breeding programs
durable resistance and, 361–64
Decline soils
take-all
specific soil suppressiveness and, 302, 310–15
Defense responses
gene expression in nematode feeding sites and, 189–94
Denaturing-gradient gel electrophoresis (DGGE)
specific soil suppressiveness and, 320
Density
host
evolutionary ecology of plant diseases in natural ecosystems and, 26–27
Density-dependent population dynamics
evolutionary ecology of plant diseases in natural ecosystems and, 12, 19–20
Determinants
antibiotic use in plant agriculture and, 444–47
avirulence
host-selective toxins and, 245–65
tobacco mosaic virus assembly and disassembly, 280–96
2,4-Diacetylphloroglucinol
specific soil suppressiveness and, 302, 312–18, 323–27
Diebacks
evolutionary ecology of plant diseases in natural ecosystems and, 17
Differential cultivars
stripe rust of wheat and barley in North America and, 96–97
Differentiation
stripe rust of wheat and barley in North America and, 78–79
Dilution extinction PCR
specific soil suppressiveness and, 321
Dioscorea deltoidea
phytochemical-based strategies for nematode control and, 226
Discula quercina
evolutionary ecology of plant diseases in natural ecosystems and, 29

Disease suppression
specific soil suppressiveness and, 302–27
Dispersal
evolutionary ecology of plant diseases in natural ecosystems and, 28–31
multiline cultivars and cultivar mixtures, 373, 380
Distribution
stripe rust of wheat and barley in North America and, 75–77, 90, 93–96
Diterpenoids
phytochemical-based strategies for nematode control and, 216, 226
Ditylenchus dipsaci
phytochemical-based strategies for nematode control and, 219, 223, 226
Diversity
antibiotic use in plant agriculture and, 445–47
evolutionary ecology of plant diseases in natural ecosystems and, 12, 19–27
multiline cultivars and cultivar mixtures, 373
specific soil suppressiveness and, 316–17
DNA exchange mechanisms
comparative genomic analysis of plant-associated bacteria and, 171
DNA polymorphisms
stripe rust of wheat and barley in North America and, 97
DNA viruses
viral sequences integrated into plant genomes and, 118–23
Docking behavior
Phytophthora-host recognition and, 140
Downregulation
gene expression in nematode feeding sites and, 197–99
Drechslera tritici-repentis
durable resistance and, 357
Drosophila melanogaster
comparative genomic analysis of plant-associated bacteria and, 176
gene expression in nematode feeding sites and, 202
viral sequences integrated into plant genomes and, 119
Durable resistance
pathogen population genetics and evolutionary potential
barley, 361
Blumeria graminis, 361
decision diagram to aid resistance breeding programs, 361–64
example plant pathosystems fit into risk model, 353–61
five evolutionary forces, 344–51
gene flow, 345–46
genetically-engineered resistance, 364–65
genotype flow, 345–46
introduction, 342–44
major gene resistance, 347–51
mating systems, 346–47
mutation, 344–45
Phytophthora infestans, 360–61
Phytophthora sojae, 360
population size, 345
potatoes, 360–61
Puccinia triticina, 359–60
quantitative resistance, 347–51
random genetic drift, 345
reproduction, 346–47
risk assessment model, 351–61
risk of pathogen evolution, 344–51
selection, 347–51
soybean, 360
wheat, 361
Xanthomonas campestris pv. *vesicatoria*, 354, 358–59
Xanthomonas oryzae pv. *oryzae*, 354, 358–59
Dynamic multiline approach
multiline cultivars and cultivar mixtures, 390

E

Ecology
antibiotic use in plant agriculture and, 444–47
evolutionary
natural ecosystems and, 12–31
molecular
specific soil suppressiveness and, 302–27
risk assessment of virus-resistant transgenic plants and, 457
Electrotaxis
Phytophthora-host recognition and, 139–40
Elicitins
Phytophthora-host recognition and, 145–49

Elicitors
Phytophthora-host recognition and, 135, 143–51
Elymus spp.
stripe rust of wheat and barley in North America and, 74–76, 78–79, 83, 85–86
Encystment
Phytophthora-host recognition and, 140–41
Endoparasites
gene expression in nematode feeding sites and, 187–206
Enterobacter cloacae
biological control of postharvest diseases of fruits and, 410
env gene
viral sequences integrated into plant genomes and, 121
Environmental Protection Agency (EPA)
biological control of postharvest diseases of fruits and, 403
Epidemiology
multiline cultivars and cultivar mixtures, 373, 376–77
stripe rust of wheat and barley in North America and, 73, 81–82, 84–88
epsp gene
virus vectors and agriculture, 53
Eragrostis curvula
phytochemical-based strategies for nematode control and, 228
Ergot
history of research, 1, 6
Erigeron philadelphicus
phytochemical-based strategies for nematode control and, 223
Erosion
durable resistance and, 347, 349–50
Erwinia spp.
antibiotic use in plant agriculture and, 434–35, 440–42
biological control of postharvest diseases of fruits and, 411
comparative genomic analysis of plant-associated bacteria and, 177
durable resistance and, 355
Erysiphe graminis
durable resistance and, 355
multiline cultivars and cultivar mixtures, 374
Erythrochiton gymnanthus
evolutionary ecology of plant diseases in natural ecosystems and, 16
Escherichia coli
comparative genomic analysis of plant-associated bacteria and, 178, 181
Phytophthora-host recognition and, 145
Eucalyptus marginata
evolutionary ecology of plant diseases in natural ecosystems and, 17
Eugenia caryophyllata
phytochemical-based strategies for nematode control and, 225
Euphorbia peplus
evolutionary ecology of plant diseases in natural ecosystems and, 21
Evolution
multiline cultivars and cultivar mixtures, 373, 385–89
stripe rust of wheat and barley in North America and, 93–96
Evolutionary ecology
plant diseases in natural ecosystems and
apparent competition, 21–22
butt rot, 17–18
cankers, 17
competition, 20–27
conclusions, 31
counterweights to numerical effects, 20
density-dependent population dynamics, 19–20
diebacks, 17
diversity, 19–27
floral diseases, 18–19
foliar diseases, 15–16
growth, 13–19
host density, 26–27
host mortality, 13–19
introduction, 12–13
Janzen-Connell hypothesis, 23–26
local adaptation, 27–31
metapopulations, 30
parasitic plants, 17
pathogen dispersal gradients, 28–29
pathogen specificity, 26–27
plant community succession, 22–23
population dynamics, 19–27
rapid evolution, 27–31
Red Queen hypothesis, 27–28
reproduction, 13–19
root rot, 17–18
scale of dispersal, 28–31

seed decay, 14–15
seedling diseases, 15
spatial patterns, 29–30
species interactions, 19–27
succession, 20–27
systemic infections, 16
temperate forests, 25–26
tropical forests, 24–25
wilts, 17
Evolutionary potential
durable resistance and, 342–65
Exobasidium vaccinii
evolutionary ecology of plant diseases in natural ecosystems and, 18
Expert system
stripe rust of wheat and barley in North America and, 106–7
Expression vectors
virus vectors and agriculture, 43–65
Exserohilum turcicum
durable resistance and, 357
multiline cultivars and cultivar mixtures, 381

F

Faramea occidentalis
evolutionary ecology of plant diseases in natural ecosystems and, 18
Fatty acids
phytochemical-based strategies for nematode control and, 223–24
Fecundity
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
Feeding sites
nematode
gene expression in, 187–206
Festuca rubra spp. *arenaria*
evolutionary ecology of plant diseases in natural ecosystems and, 22
"File drawer problem"
multiline cultivars and cultivar mixtures, 380
Fire blight
antibiotic use in plant agriculture and, 450–51
Floral diseases
evolutionary ecology of plant diseases in natural ecosystems and, 18–19
Fluorescently tagged amplified ribosomal DNA restriction analyses (FT-ARDRA)
specific soil suppressiveness and, 319–21
Fluorescent pseudomonads
specific soil suppressiveness and, 312
Foeniculum vulgare
phytochemical-based strategies for nematode control and, 225
Foliar diseases
evolutionary ecology of plant diseases in natural ecosystems and, 15–16
Foliar pathogens
multiline cultivars and cultivar mixtures, 374–80
Food and Drug Administration (FDA)
virus vectors and agriculture, 62
Foot and mouth disease virus
virus vectors and agriculture, 48–49, 51
Forests
evolutionary ecology of plant diseases in natural ecosystems and, 24–26
Forms
differentiation of
stripe rust of wheat and barley in North America and, 78–79
Fort Detrick theory
stripe rust of wheat and barley in North America and, 84–85
Fruits
antibiotic use in plant agriculture and, 437–39
biological control of postharvest diseases of, 403–23
Fulvia fulva
durable resistance and, 355
Functional production vector properties
virus vectors and agriculture, 53–64
Fungi
host-selective toxins and avirulence determinants, 245–65
phytochemical-based strategies for nematode control and, 216, 231–33
Phytophthora-host recognition and, 135–56
specific soil suppressiveness and, 302
stripe rust of wheat and barley in North America and, 73–107
Fungicides
biological control of postharvest diseases of fruits and, 403–23
stripe rust of wheat and barley in North America and, 105–6
Fusarium spp.
durable resistance and, 353, 355, 362–63
evolutionary ecology of plant diseases in natural ecosystems and, 17–18

history of research, 6
phytochemical-based strategies for nematode control and, 219, 232–33
Phytophthora-host recognition and, 150–51
specific soil suppressiveness and, 303
Fusarium wilt
specific soil suppressiveness and, 302, 306–8

G

Gaeummanomyces graminis
biological control of postharvest diseases of fruits and, 414
history of research, 9
specific soil suppressiveness and, 302–27
Galanthus nivalis
phytochemical-based strategies for nematode control and, 230
Gene flow
durable resistance and, 342, 345–46
risk assessment of virus-resistant transgenic plants and, 465–71
Gene-for-gene resistance
durable resistance and, 343
Gene function discovery
virus vectors and agriculture, 51–53
General suppression
specific soil suppressiveness and, 304
Genetically-engineered resistance
durable resistance and, 364–65
Genetically-modified organisms (GMOs)
risk assessment of virus-resistant transgenic plants and, 457, 468
Genomics
comparative genomic analysis of plant-associated bacteria and, 166–83
Phytophthora-host recognition and, 155–56
viral sequences integrated into plant genomes and, 117–32
virus vectors and agriculture, 43–65
Genotypes
durable resistance and, 342, 345–46
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
multiline cultivars and cultivar mixtures, 381
risk assessment of virus-resistant transgenic plants and, 464–71
Gentamicin
antibiotic use in plant agriculture and, 436–37
Geotrichum candidum
biological control of postharvest diseases of fruits and, 421
Germination
Phytophthora-host recognition and, 140–41
stripe rust of wheat and barley in North America and, 77–78, 87–88
gfp gene
virus vectors and agriculture, 46–47, 64
Giant cells
gene expression in nematode feeding sites and, 199–203
Gliocladium roseum
biological control of postharvest diseases of fruits and, 415
Globodera spp.
gene expression in nematode feeding sites and, 187–88, 190–94, 198, 204–5
phytochemical-based strategies for nematode control and, 219, 221, 224–25, 229–32
Glomerella graminicola
durable resistance and, 355
Gloriosa superba
phytochemical-based strategies for nematode control and, 223
Glucosinolates
phytochemical-based strategies for nematode control and, 216
Glycine max
durable resistance and, 360
gene expression in nematode feeding sites and, 194, 198
multiline cultivars and cultivar mixtures, 384
Phytophthora-host recognition and, 152
GntI gene
virus vectors and agriculture, 57
Gossypium hirsutum
gene expression in nematode feeding sites and, 194
phytochemical-based strategies for nematode control and, 225
gpe-1 gene
Phytophthora-host recognition and, 150
Grains
multiline cultivars and cultivar mixtures, 373–80
Green bridge

stripe rust of wheat and barley in North America and, 91
Groundnut rosette assistor luteovirus
risk assessment of virus-resistant transgenic plants and, 463
Groundnut rosette virus
risk assessment of virus-resistant transgenic plants and, 463
Growth
evolutionary ecology of plant diseases in natural ecosystems and, 13–19

H

Haemophilus influenzae
comparative genomic analysis of plant-associated bacteria and, 178–79
Hannoa undulata
phytochemical-based strategies for nematode control and, 226
HC-toxin
host-selective toxins and avirulence determinants, 253–55
Helenium sp.
phytochemical-based strategies for nematode control and, 222
Helianthus annuus
gene expression in nematode feeding sites and, 194
phytochemical-based strategies for nematode control and, 218
Helicobacter pylori
comparative genomic analysis of plant-associated bacteria and, 176, 178
Helminthosporium sp.
durable resistance and, 357
multiline cultivars and cultivar mixtures, 384
Hemagglutinins
comparative genomic analysis of plant-associated bacteria and, 166
Hemileia vastatrix
multiline cultivars and cultivar mixtures, 382
Hemolysins
comparative genomic analysis of plant-associated bacteria and, 166
Heterobasidion annosum
evolutionary ecology of plant diseases in natural ecosystems and, 17–18, 26
Heterodera spp.
durable resistance and, 355
gene expression in nematode feeding sites and, 187–94, 197–98, 204
phytochemical-based strategies for nematode control and, 218, 221, 224–25, 227, 229–30, 232–33
specific soil suppressiveness and, 303
Heterologous encapsidation
risk assessment of virus-resistant transgenic plants and, 457, 461–64
Heterorhabditis sp.
phytochemical-based strategies for nematode control and, 233
High-temperature, adult-plant (HTAP) resistance
stripe rust of wheat and barley in North America and, 100–5
Higher plants
phytochemical-based strategies for nematode control and, 218–30
Hordeum spp.
multiline cultivars and cultivar mixtures, 374
stripe rust of wheat and barley in North America and, 74, 76, 79, 85–86, 99
Hordiviruses
virus vectors and agriculture, 46
Horizontal gene transfer
antibiotic use in plant agriculture and, 445–47
comparative genomic analysis of plant-associated bacteria and, 171
Host density
evolutionary ecology of plant diseases in natural ecosystems and, 26–27
Host geometry
multiline cultivars and cultivar mixtures, 381–82
Hostile environment
specific soil suppressiveness and, 324–26
Host mortality
evolutionary ecology of plant diseases in natural ecosystems and, 13–19
Host population dynamics
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
Host range
risk assessment of virus-resistant transgenic plants and, 461–62
stripe rust of wheat and barley in North America and, 75–77

Host-pathogen specificity
multiline cultivars and cultivar mixtures, 382–83
Host-pathogen symbiosis
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
Host-selective toxins
avirulence determinants and
AAL-toxins, 251–52
Alternaria alternata, 258–60
avirulence gene products, 263–64
biosynthesis, 258–64
Bipolaris sacchari, 260
Cochliobolus spp., 260–62
compatibility, 256–58
conclusions, 264–65
HC-toxin, 253–55
host responses, 247–56
incompatibility, 256–58
introduction, 245–47
miscellaneous host-selective toxins, 255–56, 263
Periconia circinata, 262
programmed cell death, 256–58
Pyrenophora tritici-repentis, 262–63
structure, 258–64
symptoms, 247
T-toxin, 252–53
victorin, 248–51
Human immunodeficiency virus type 1 (HIV-1)
virus vectors and agriculture, 45, 50
Hypersensitive response
host-selective toxins and avirulence determinants, 246–47
tobacco mosaic virus assembly and disassembly, 280, 286–88, 290

I

Impatiens capensis
evolutionary ecology of plant diseases in natural ecosystems and, 21
Incompatibility
host-selective toxins and avirulence determinants, 245–46, 256–58
Induced suppression
specific soil suppressiveness and, 304, 309–10
Inf1 gene
Phytophthora-host recognition and, 146
Infections
evolutionary ecology of plant diseases in natural ecosystems and, 16
gene expression in nematode feeding sites and, 189–94
stripe rust of wheat and barley in North America and, 77–78, 87–88
Insect vectors
multiline cultivars and cultivar mixtures, 373
Integrated viral sequences
plant genomes and, 117–32
Integrated control
stripe rust of wheat and barley in North America and, 88–89
Integrated pest management (IPM)
history of research, 9
Inula helenium
phytochemical-based strategies for nematode control and, 225
Iris japonica
phytochemical-based strategies for nematode control and, 224
Isoflavones
Phytophthora-host recognition and, 135–56
Isothiocyanates
phytochemical-based strategies for nematode control and, 216, 221–22

J

Janzen-Connell hypothesis
evolutionary ecology of plant diseases in natural ecosystems and, 12, 23–26

K

Karnal bunt
history of research, 1, 8–9
Knema hookeriana
phytochemical-based strategies for nematode control and, 228
Krigia dandelion
evolutionary ecology of plant diseases in natural ecosystems and, 22
Kummerowia stipulacea
evolutionary ecology of plant diseases in natural ecosystems and, 20

L

Labyrinthula spp.
evolutionary ecology of plant diseases in natural ecosystems and, 16
Lachnum papyraceum
phytochemical-based strategies for nematode control and, 232
Lactarius spp.
phytochemical-based strategies for nematode control and, 232
Lactuca sativa

evolutionary ecology of plant diseases in natural ecosystems and, 21
Lantana camara
phytochemical-based strategies for nematode control and, 227, 229
Large spatial scale
multiline cultivars and cultivar mixtures, 379–80
Larix spp.
evolutionary ecology of plant diseases in natural ecosystems and, 15
Leaky readthrough
virus vectors and agriculture, 51
Leifsonia xyli
comparative genomic analysis of plant-associated bacteria and, 183
Leptosphaeria maculans
durable resistance and, 355
Lesion expansion
multiline cultivars and cultivar mixtures, 380–81
Linum marginale
evolutionary ecology of plant diseases in natural ecosystems and, 28, 30
Lipids
phytochemical-based strategies for nematode control and, 216, 223–24
Lithocarpus densiflorus
evolutionary ecology of plant diseases in natural ecosystems and, 17
Local adaptation
evolutionary ecology of plant diseases in natural ecosystems and, 12, 27–31
Long-standing suppression
specific soil suppressiveness and, 304
Loss assessment
stripe rust of wheat and barley in North America and, 90–91
Loss of susceptibility
virus vectors and agriculture, 54
Lotus japonicus
Phytophthora-host recognition and, 144
Lupinus albus
Phytophthora-host recognition and, 144
Lycopersicon spp.
gene expression in nematode feeding sites and, 194
phytochemical-based strategies for nematode control and, 219
Phytophthora-host recognition and, 144
risk assessment of virus-resistant transgenic plants and, 465

M

Magnaporthe grisea
durable resistance and, 355, 362–63
multiline cultivars and cultivar mixtures, 374
Major gene resistance
durable resistance and, 342–65
Malus spp.
multiline cultivars and cultivar mixtures, 382
phytochemical-based strategies for nematode control and, 228
Manihot esculenta
phytochemical-based strategies for nematode control and, 222
Marasmius conigeus
phytochemical-based strategies for nematode control and, 232
Marker-assisted breeding for resistance
stripe rust of wheat and barley in North America and, 104–5
Marketing
multiline cultivars and cultivar mixtures, 373
Mathre DE, 1–11
Mating systems
durable resistance and, 346–47
Medicago spp.
gene expression in nematode feeding sites and, 194
Phytophthora-host recognition and, 144, 155
Melampsora spp.
durable resistance and, 355–56
evolutionary ecology of plant diseases in natural ecosystems and, 21, 28, 30
multiline cultivars and cultivar mixtures, 382
Meloidogyne spp.
durable resistance and, 354, 356, 359
gene expression in nematode feeding sites and, 187–88, 190–94, 198, 200–1, 203–5
phytochemical-based strategies for nematode control and, 218–33
specific soil suppressiveness and, 303
Mentha piperatum
phytochemical-based strategies for nematode control and, 224
Mesorhizobium loti
comparative genomic

analysis of
plant-associated bacteria
and, 166–83
Metabolism
comparative genomic
analysis of
plant-associated bacteria
and, 171–74
Metapopulations
evolutionary ecology of
plant diseases in natural
ecosystems and, 30
Metchnikowia pulchereima
biological control of
postharvest diseases of
fruits and, 409
Methyl bromide
history of research, 8
Microbial
interaction/antagonists
biological control of
postharvest diseases of
fruits and, 403–23
Microbial populations
specific soil
suppressiveness and,
302–27
Microbotrytum violaceum
evolutionary ecology of
plant diseases in natural
ecosystems and, 18
Mimosa pigra
evolutionary ecology of
plant diseases in natural
ecosystems and, 14
Mixed cultures
biological control of
postharvest diseases of
fruits and, 412–13
multiline cultivars and
cultivar mixtures, 373–93
Molecular ecology
specific soil
suppressiveness and,
302–27
Monilinia fructicola
biological control of
postharvest diseases of
fruits and, 406, 408–9
Mucuna spp.
phytochemical-based
strategies for nematode
control and, 224
Multiline cultivars
cultivar mixtures and
alternative mechanisms,
387–89
autoinfection/
alloinfection ratio,
380
conclusions, 392–93
dispersal, 380
epidemic intensity,
376–77
experimental procedure
and design, 378
factors determining
mixture impacts on
other pathosystems,
380–85
host geometry, 381–82
host-pathogen
specificity, 382–83
implementation, 390–92
introduction, 373–74
large spatial scale,
379–80
lesion expansion,
380–81
mixture composition,
375–76
nature of disease spread,
378–79
pathogen evolution in
mixtures, 385–89
soilborne pathogens,
384–85
spatial scale, 377–80
specialized, foliar
pathogens of small
grains, 374–80
viruses, 383–84
Musa spp.
viral sequences integrated
into plant genomes and,
127, 130–31
Mutation-determined
resistance
antibiotic use in plant
agriculture and, 440–41
Mycelia sterila
phytochemical-based
strategies for nematode
control and, 232
Myocosphaerella spp.
durable resistance and,
347, 356
evolutionary ecology of
plant diseases in natural
ecosystems and, 15
multiline cultivars and
cultivar mixtures, 388
phytochemical-based
strategies for nematode
control and, 232
Myrocethium vereucaria
phytochemical-based
strategies for nematode
control and, 231

N

Natural ecosystems
evolutionary ecology of
plant diseases in, 12–31
Naturally-occuring products
phytochemical-based
strategies for nematode
control and, 216–35
Necrosis
tobacco mosaic virus
assembly and
disassembly, 280, 290–91
Nectandra spp.
evolutionary ecology of
plant diseases in natural
ecosystems and, 25
Nectria haematococca
durable resistance and,
347
Negative feedbacks
evolutionary ecology of

plant diseases in natural ecosystems and, 22
Neisseria meningitidis
comparative genomic analysis of plant-associated bacteria and, 181
Nematicides
phytochemical-based strategies for nematode control and, 216–35
Nematodes
gene expression in nematode feeding sites and
biotechnological applications, 205–6
cause and effect, 195–97
cell differentiation pathways, 199–203
defense responses in infected roots, 189–94
gene downregulation, 197–99
gene upregulation, 195–97
giant cell formation, 199–203
introduction, 187–88
manipulation of plant root, 203–5
sedentary nematodes and their feeding sites, 188–89
specificity of nematode-responsive gene expression, 205–6
syncytial formation, 199–203
wound responses in infected roots, 189–94
phytochemical-based strategies for control of
algae, 231
alkaloids, 223
Asteraceae, 222–23
Brassicaceae, 221–22
cyanogenic glycosides, 222
diterpenoids, 226
fatty acids and derivatives, 223–24
fungi, 231–33
higher plants, 218–30
introduction, 216–18
isothiocyanates, 221–22
miscellaneous compounds, 229–30
outlook, 233–35
phenolics, 227–29
polyacetylenes, 222–23
polythienyls, 218–21
quassinoids, 226–27
sesquiterpenoids, 225–26
steroids, 226–27
Tagetes spp., 218–21
terpenoids, 224–25
triterpenoids, 226–27
Neobulgaria pura
phytochemical-based strategies for nematode control and, 232
New agriculture
virus vectors and, 43–65
Nicotiana spp.
gene expression in nematode feeding sites and, 194, 198
phytochemical-based strategies for nematode control and, 219
Phytophthora-host recognition and, 146–47, 149–50, 155
tobacco mosaic virus assembly and disassembly, 293–94
viral sequences integrated into plant genomes and, 126–30
virus vectors and agriculture, 47–49, 52–55, 59, 62, 64
Nippostrongylus brasiliensis
phytochemical-based strategies for nematode control and, 231
Nonactivated integrated sequences
viral sequences integrated into plant genomes and, 129
Nonspecific antagonism
specific soil suppressiveness and, 304
North America
stripe rust of wheat and barley in, 73–107
Numerical effects
counterweights to evolutionary ecology of plant diseases in natural ecosystems and, 20

O

Ocimum spp.
phytochemical-based strategies for nematode control and, 224, 227
Ocotea spp.
evolutionary ecology of plant diseases in natural ecosystems and, 25
Omphalotis nita
phytochemical-based strategies for nematode control and, 232
Opuntia engelmannii lindheimeri
phytochemical-based strategies for nematode control and, 218
Orchards
antibiotic use in plant agriculture and, 443–44
Origanum spp.
phytochemical-based strategies for nematode control and, 225

Oryzae sativa
multiline cultivars and cultivar mixtures, 374
viral sequences integrated into plant genomes and, 129
Oxidative stress
comparative genomic analysis of plant-associated bacteria and, 166, 179–80
Oxolinic acid
antibiotic use in plant agriculture and, 437
Oxytetracycline
antibiotic use in plant agriculture and, 434, 436

P

Paecilomyces lilacinus
phytochemical-based strategies for nematode control and, 232
Panagrellus redivivus
phytochemical-based strategies for nematode control and, 224
Panagrolaimus sp.
phytochemical-based strategies for nematode control and, 223
Panicum spp.
evolutionary ecology of plant diseases in natural ecosystems and, 22
Pantoea agglomerans
biological control of postharvest diseases of fruits and, 416
Paracercospora fijiensis
durable resistance and, 356
Pararetroviruses
viral sequences integrated into plant genomes and, 117–32
Parasites
evolutionary ecology of plant diseases in natural ecosystems and, 17
phytochemical-based strategies for nematode control and, 216–35
Parasponia andersonii
gene expression in nematode feeding sites and, 194
Paratrichodorus christiei
phytochemical-based strategies for nematode control and, 230
Parsley
Phytophthora-host recognition and, 149–50
Pasteuria penetrans
specific soil suppressiveness and, 305
Pathogen dispersal gradients
evolutionary ecology of plant diseases in natural ecosystems and, 28–29
Pathogen evolution
multiline cultivars and cultivar mixtures, 373, 385–89
Pathogen specificity
evolutionary ecology of plant diseases in natural ecosystems and, 26–27
pds gene
virus vectors and agriculture, 52
Pear production
antibiotic use in plant agriculture and, 449–50
Pectinobacteria chrysantemi
comparative genomic analysis of plant-associated bacteria and, 177
Pelargonium graveolens
phytochemical-based strategies for nematode control and, 225
Penicillium spp.
biological control of postharvest diseases of fruits and, 405–7, 409, 411, 413, 418–20
phytochemical-based strategies for nematode control and, 232–33
Pennisetum glaucum
multiline cultivars and cultivar mixtures, 390
Periconia circinata
host-selective toxins and avirulence determinants, 262
Peronospora parasitica
evolutionary ecology of plant diseases in natural ecosystems and, 16
Phytophthora-host recognition and, 154
Persistence
antibiotic use in plant agriculture and, 443
Petunia vein clearing virus
viral sequences integrated into plant genomes and, 117, 128, 130
Pezicula malicorticis
biological control of postharvest diseases of fruits and, 406, 415
Phaeosphaeria nodorum
durable resistance and, 347, 356
Phaseolus vulgaris
multiline cultivars and cultivar mixtures, 380
phytochemical-based strategies for nematode control and, 227
Phytophthora-host recognition and, 144
Phellinus weirii
evolutionary ecology of plant diseases in natural ecosystems and, 17, 23, 26

Phenolics
phytochemical-based strategies for nematode control and, 216, 227–29
Phenotypic analysis
host-selective toxins and avirulence determinants, 245
risk assessment of virus-resistant transgenic plants and, 461–64
Phialophora spp.
history of research, 9
phlA gene
specific soil suppressiveness and, 324
phld+ gene
specific soil suppressiveness and, 313, 315–17, 322
Phlebia gigantea
biological control of postharvest diseases of fruits and, 406
Phleum pratense
phytochemical-based strategies for nematode control and, 224
Phoma lingam
durable resistance and, 355
Phylloporia chrysita
evolutionary ecology of plant diseases in natural ecosystems and, 16
Physostigma venenosum
phytochemical-based strategies for nematode control and, 223
Phytohormones
comparative genomic analysis of plant-associated bacteria and, 180–81
Phytophthora-host recognition
avirulence genes, 151–55
cell wall fragments, 144–45
chemotropism, 141–42
docking behavior, 140
elicitins, 145–49
elicitors, 143–51
encystment, 140–41
genetically-defined recognition events, 151–55
genomics, 155–56
germination, 140–41
host, 143–55
introduction, 135–37
outstanding issues, 154–55
pathogens, 137–43
P. infestans on potato and tomato, 152
P. sojae 42-kDa elicitor of parsley, 149–50
P. sojae Avr1b cloning and characterization, 152–54
P. sojae on soybean, 152
R genes, 151–55
summary, 142–43
thigmotropism, 141–42
zoospore chemotaxis, 137–39
zoospore electrotaxis, 139–40
Phytophthora spp.
durable resistance and, 356, 360–62
evolutionary ecology of plant diseases in natural ecosystems and, 15, 17, 25
multiline cultivars and cultivar mixtures, 377, 384
specific soil suppressiveness and, 303
Pichia spp.
biological control of postharvest diseases of fruits and, 410, 418, 421
Phytophthora-host recognition and, 153
Pinus spp.
evolutionary ecology of plant diseases in natural ecosystems and, 18
phytochemical-based strategies for nematode control and, 226, 228
Plant community succession
evolutionary ecology of plant diseases in natural ecosystems and, 12, 22–23
Plantago lanceolata
evolutionary ecology of plant diseases in natural ecosystems and, 18
Plasmid/transposon-determined resistance
antibiotic use in plant agriculture and, 441–42
Plasmodiophora brassicae
specific soil suppressiveness and, 303
Platypodium elegans
evolutionary ecology of plant diseases in natural ecosystems and, 24
Plectus spp.
phytochemical-based strategies for nematode control and, 224
Pleurotus spp.
phytochemical-based strategies for nematode control and, 232
Plum pox virus
risk assessment of virus-resistant transgenic plants and, 462
virus vectors and agriculture, 45, 48, 50
(+) strand RNA virus systems
virus vectors and agriculture, 43, 45, 47–48
Poa pratensis

stripe rust of wheat and barley in North America and, 73
pol gene
viral sequences integrated into plant genomes and, 121
Polyacetylenes
phytochemical-based strategies for nematode control and, 216, 222–23
Polymerase chain reaction (PCR)
specific soil suppressiveness and, 318, 320–22
virus vectors and agriculture, 45, 55, 59
Polymyxa spp.
multiline cultivars and cultivar mixtures, 384
risk assessment of virus-resistant transgenic plants and, 467
Polythienyls
phytochemical-based strategies for nematode control and, 216, 218–21
Population dynamics
evolutionary ecology of plant diseases in natural ecosystems and, 19–27
Population genetics
durable resistance and, 342–65
Populus spp.
multiline cultivars and cultivar mixtures, 382
Portulaca spp.
evolutionary ecology of plant diseases in natural ecosystems and, 20
risk assessment of virus-resistant transgenic plants and, 468
Postharvest diseases of fruits
biological control and, 403–23
Posttranscriptional gene silencing
risk assessment of virus-resistant transgenic plants and, 460
Potato
durable resistance and, 360–61
Phytophthora-host recognition and, 152
Potato leafroll virus
risk assessment of virus-resistant transgenic plants and, 464
Potato scab
specific soil suppressiveness and, 302
Potato scab decline
specific soil suppressiveness and, 308–9
Potato spindle tuber viroid
risk assessment of virus-resistant transgenic plants and, 464
Potato virus A
risk assessment of virus-resistant transgenic plants and, 473
Potato virus X
risk assessment of virus-resistant transgenic plants and, 464
virus vectors and agriculture, 45, 48–52, 56–57, 64
Potato virus Y
risk assessment of virus-resistant transgenic plants and, 464
virus vectors and agriculture, 45, 48
Potex
virus vectors and agriculture, 46
Potyvirus
virus vectors and agriculture, 46, 49, 57, 64
Powdery mildew
multiline cultivars and cultivar mixtures, 373
Pratylenchus spp.
durable resistance and, 356
phytochemical-based strategies for nematode control and, 218–19, 221–24, 228–33
Prediction
stripe rust of wheat and barley in North America and, 73, 88–107
Preharvest
biological control of postharvest diseases of fruits and, 415–16
Prevalence
stripe rust of wheat and barley in North America and, 90
Programmed cell death
host-selective toxins and avirulence determinants, 245–46, 256–58
Prunus serotina
evolutionary ecology of plant diseases in natural ecosystems and, 15
Pseudocercosporella herpotrichoides
durable resistance and, 356
multiline cultivars and cultivar mixtures, 384–85
Pseudomonas spp.
antibiotic use in plant agriculture and, 434, 442–43
biological control of postharvest diseases of fruits and, 406, 412, 414, 416, 418–20

comparative genomic analysis of plant-associated bacteria and, 176–78
specific soil suppressiveness and, 302–27
virus vectors and agriculture, 50
Pseudotsuga menziesii
evolutionary ecology of plant diseases in natural ecosystems and, 17
psy gene
virus vectors and agriculture, 52
Puccinia spp.
durable resistance and, 356–57, 359–60
evolutionary ecology of plant diseases in natural ecosystems and, 18, 21, 27, 31
multiline cultivars and cultivar mixtures, 374–75, 377, 386, 389
stripe rust of wheat and barley in North America and, 73–107
Pycnanthus angolensis
phytochemical-based strategies for nematode control and, 229
Pyrenophora tritici-repentis
durable resistance and, 357
host-selective toxins and avirulence determinants, 262–63
Pyricularia grisea
durable resistance and, 355
Pythium spp.
evolutionary ecology of plant diseases in natural ecosystems and, 15, 20, 26
history of research, 6
Phytophthora-host recognition and, 136, 138–39, 145, 150–51
specific soil suppressiveness and, 303

Q

Quantitative resistance
durable resistance and, 342–65
Quassia amara
phytochemical-based strategies for nematode control and, 226
Quassinoids
phytochemical-based strategies for nematode control and, 216, 226–27
Quercus spp.
evolutionary ecology of plant diseases in natural ecosystems and, 17, 23, 29
phytochemical-based strategies for nematode control and, 218, 229

R

Rabbit hemorehagic disease virus
virus vectors and agriculture, 49, 51
Races
stripe rust of wheat and barley in North America and, 78–79, 83–84, 93, 96–97, 102, 104
Radopholus similis
phytochemical-based strategies for nematode control and, 218
Ralstonia solanacearum
comparative genomic analysis of plant-associated bacteria and, 166–83
specific soil suppressiveness and, 303
Random genetic drift
durable resistance and, 345
Rapid evolution
evolutionary ecology of plant diseases in natural ecosystems and, 27–31
Real-time PCR
specific soil suppressiveness and, 321
Receptors
Phytophthora-host recognition and, 135–56
Recombinant proteins
virus vectors and agriculture, 43–65
Recombination
risk assessment of virus-resistant transgenic plants and, 469–71
Red Queen hypothesis
evolutionary ecology of plant diseases in natural ecosystems and, 27–28
Regulation
antibiotic use in plant agriculture and, 439
Release testing
virus vectors and agriculture, 61–62
Reproduction
durable resistance and, 346–47
evolutionary ecology of plant diseases in natural ecosystems and, 13–19
Resistance
antibiotic use in plant agriculture and, 434–51
biological control of postharvest diseases of fruits and, 403–23
durable resistance and, 342–65
risk assessment of virus-resistant transgenic plants and, 457–74
stripe rust of wheat and

barley in North America and, 73, 82–83, 99, 102, 104–5
tobacco mosaic virus assembly and disassembly, 280, 286–89
Resistance breakdown
risk assessment of virus-resistant transgenic plants and, 472–73
Resistance gene analog polymorphism (RGAP)
stripe rust of wheat and barley in North America and, 104
Resistant genotypes
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
Restriction fragment length polymorphisms (RFLPs)
specific soil suppressiveness and, 320–21
Retrotransposons
viral sequences integrated into plant genomes and, 118–23
Reverse transcriptase-mediated PCR (RT-PCR)
specific soil suppressiveness and, 321
Reverse transcriptase-polymerase chain reaction (RT-PCR)
virus vectors and agriculture, 45, 54–55, 62, 64
R genes
durable resistance and, 351
Phytophthora-host recognition and, 151–55
Rhabditis spp.
phytochemical-based strategies for nematode control and, 223–24, 228
Rhizobium leguminarosum
gene expression in nematode feeding sites and, 200, 203
Rhizoctonia solani
durable resistance and, 357, 362
multiline cultivars and cultivar mixtures, 384
Phytophthora-host recognition and, 145
specific soil suppressiveness and, 303
Rhizophora mangle
phytochemical-based strategies for nematode control and, 218
Rhizopus stolonifer
biological control of postharvest diseases of fruits and, 410
Rhizosphere
specific soil suppressiveness and, 302–27
Rhododendron calendulaceum
evolutionary ecology of plant diseases in natural ecosystems and, 18
Rhodotorula glutinis
biological control of postharvest diseases of fruits and, 414–15
Rhus aromatica
phytochemical-based strategies for nematode control and, 218
Rhynchosporium secalis
durable resistance and, 347
multiline cultivars and cultivar mixtures, 382
Rhyncolacis penicillata
phytochemical-based strategies for nematode control and, 228
Rhyncosporium secalis
durable resistance and, 357
Rice tungro bacilliform virus
viral sequences integrated into plant genomes and, 129
Risk assessment
durable resistance and, 342, 344–61
virus-resistant transgenic plants and, 457–74
RNA interference (RNAi)
virus vectors and agriculture, 56
RNA virus systems
(+) strand
virus vectors and agriculture, 43, 45, 47
Root rot
evolutionary ecology of plant diseases in natural ecosystems and, 17–18
Roots
gene expression in nematode feeding sites and, 187–206
Rotylenchulus reniformis
phytochemical-based strategies for nematode control and, 218
Rpp genes
Phytophthora-host recognition and, 154
Rps genes
Phytophthora-host recognition and, 135, 152–55
Rudbeckia hirta
phytochemical-based strategies for nematode control and, 222
Rusts
multiline cultivars and cultivar mixtures, 373

S

Saccharomyces cerevisiae
biological control of

postharvest diseases of fruits and, 410, 419
Salix viminalis
evolutionary ecology of plant diseases in natural ecosystems and, 21
Satellite RNA
risk assessment of virus-resistant transgenic plants and, 464–65
Scale of dispersal
evolutionary ecology of plant diseases in natural ecosystems and, 28–31
Scale up
vector
virus vectors and agriculture, 53–55
Schizosaccharomyces pombe
risk assessment of virus-resistant transgenic plants and, 459
Sclerospora graminicola
durable resistance and, 357
Sclerotinia sclerotiorum
durable resistance and, 357, 363
Scolecopeltidium mavteni
evolutionary ecology of plant diseases in natural ecosystems and, 29
Secale spp.
phytochemical-based strategies for nematode control and, 224
stripe rust of wheat and barley in North America and, 85
Secretion systems
comparative genomic analysis of plant-associated bacteria and, 175–76
Sedentary root endoparasitic nematodes
gene expression in nematode feeding sites and, 187–206
Seed decay
evolutionary ecology of plant diseases in natural ecosystems and, 14–15
Seedling diseases
evolutionary ecology of plant diseases in natural ecosystems and, 15
Seed shadow
evolutionary ecology of plant diseases in natural ecosystems and, 23
Selection
durable resistance and, 347–51
stripe rust of wheat and barley in North America and, 99–100
Senecio vulgaris
evolutionary ecology of plant diseases in natural ecosystems and, 21
Septoria tritici
durable resistance and, 356
Sesquiterpenoids
phytochemical-based strategies for nematode control and, 216, 225–26
Setosphaeria turcica
durable resistance and, 357
Severity
stripe rust of wheat and barley in North America and, 90
Shepherds purse
evolutionary ecology of plant diseases in natural ecosystems and, 16
Silene spp.
evolutionary ecology of plant diseases in natural ecosystems and, 18
Sinapsis spp.
phytochemical-based strategies for nematode control and, 221
Sinorhizobium meliloti
comparative genomic analysis of plant-associated bacteria and, 166–83
Sitanion hystrix
stripe rust of wheat and barley in North America and, 75
Sitanion spp.
stripe rust of wheat and barley in North America and, 86
Slot-blot hybridization
specific soil suppressiveness and, 318
Small grains
multiline cultivars and cultivar mixtures, 373–80
Smut diseases
history of research, 6–9
Soilborne pathogens
multiline cultivars and cultivar mixtures, 384–85
specific soil suppressiveness and, 302–27
Solanum tuberosum
gene expression in nematode feeding sites and, 194, 198
multiline cultivars and cultivar mixtures, 377
phytochemical-based strategies for nematode control and, 225
Solidago canadensis
phytochemical-based strategies for nematode control and, 222
Sophora flavescens
phytochemical-based strategies for nematode control and, 223
Sorbaria sorbifolia
phytochemical-based strategies for nematode

control and, 228
Sorghum spp.
multiline cultivars and cultivar mixtures, 381
phytochemical-based strategies for nematode control and, 222
Spartina pectinata
evolutionary ecology of plant diseases in natural ecosystems and, 31
Spatial patterning
durable resistance and, 350
evolutionary ecology of plant diseases in natural ecosystems and, 29–30
Spatial scale
evolutionary ecology of plant diseases in natural ecosystems and, 12
multiline cultivars and cultivar mixtures, 377–80
Species interactions
evolutionary ecology of plant diseases in natural ecosystems and, 19–27
Specific soil suppressiveness
microbial populations and plant pathogens
apple replant disease, 309–10
characteristics of suppressive soils, 304–6, 317–24
competing in hostile environment, 324–26
conclusions, 326–27
2,4-diacetylphloroglucinol, 312–17
disease suppression, 315–16
examples of suppressive soils, 306–17
fluorescent pseudomonads, 312
functional analysis of key populations involved in soil suppressiveness, 322–24
Fusarium wilt, 306–8
future research, 326–27
genetic diversity, 316–17
induction of suppressiveness, 309–10
introduction, 303–4
molecular approaches to characterizing soil microbial communities, 318–22
potato scab decline, 308–9
Pseudomonas fluorescens, 316–17
research strategies, 305
take-all decline, 310–15
Specificity
evolutionary ecology of plant diseases in natural ecosystems and, 26–27
gene expression in nematode feeding sites and, 205–6
multiline cultivars and cultivar mixtures, 373, 382–83
risk assessment of virus-resistant transgenic plants and, 461–62
Spilocea inequalis
durable resistance and, 358
Spiraea salicifolia
phytochemical-based strategies for nematode control and, 228
Splash dispersal
multiline cultivars and cultivar mixtures, 373
Sporisorium reilanum
durable resistance and, 357
Sporobolomyces roseus
biological control of postharvest diseases of fruits and, 410, 412
Sporulation
stripe rust of wheat and barley in North America and, 77–78
Spread
stripe rust of wheat and barley in North America and, 78
Stagnospora nodorum
durable resistance and, 356
Staphylococcus aureus
virus vectors and agriculture, 50
Steinernema glaseri
phytochemical-based strategies for nematode control and, 219
Stellaria media
risk assessment of virus-resistant transgenic plants and, 468
Steroids
phytochemical-based strategies for nematode control and, 216, 226–27
Streptomyces spp.
phytochemical-based strategies for nematode control and, 234
Phytophthora-host recognition and, 151
specific soil suppressiveness and, 303
Streptomycin
antibiotic use in plant agriculture and, 434, 436, 439–45
Stripe rust
of wheat and barley in North America
aggressiveness, 93–96
assessment of damage, 84–88
breeding for resistance, 82–83

Central United States:
late 1950s, 80–81
chemical control, 105–6
climate changes, 91–92
Cold War research, 84
crop management, 91
cultivar resistance,
75–77
differentiation of forms
and races, 78–79
discovery, 74
disease expression,
87–88
distribution, 75–77, 90,
93–96
DNA polymorphisms,
97
early years: 1915 to
early 1930s, 74–79
epidemiology, 84–88
evolution, 93–96
expert system for
managing wheat and
barley diseases, 106–7
forms, 92–93
Fort Detrick theory,
84–85
genetics, 82–83, 99,
102–4
germination, 77–78,
87–88
green bridge, 91
high-temperature,
adult-plant resistance
in wheat, 102–4
host range, 75–77
importance, 75–77
infection, 77–78, 87–88
integrated control, 88–89
introduction, 73
loss assessment, 90–91
marker-assisted breeding
for resistance, 104–5
microscopic studies,
77–78
monitoring, 90
new crises, 88–89
new forms and races,
83–84
new problem of potential
danger, 74–75
new research in Western
United States, 81–82
new system for
identifying races of
Puccinia striiformis sp.
tritici, 93
origin, 75
personnel changes,
88–89
posible mechanism of
genetic changes, 99
prediction and control:
1968 to 2000, 88–107
prevalence, 90
races, 93, 97
race-specific, seedling
resistance in barley,
104
race-specific, seedling
resistance in wheat,
102
relationships of North
American and
European races and
differential cultivars,
96–97
research hiatus:
mid-1930s to
mid-1950s, 79–80
resistance, 99–100
severe epidemics, 81–82
severity, 90
source, 75
sporulation, 77–78
spread, 78
summer survival, 85–87
survival, 78
virulence, 90, 93, 97
Western United States:
renewal of research,
1960 to 1967, 81–88
winter survival, 85–87
Strobilomyces floccopus
phytochemical-based
strategies for nematode
control and, 232
Strychnos mitis
evolutionary ecology of
plant diseases in natural
ecosystems and, 14
Succession
evolutionary ecology of
plant diseases in natural
ecosystems and, 12,
20–27
Summer survival
stripe rust of wheat and
barley in North America
and, 85–87
Surface structural elements
comparative genomic
analysis of
plant-associated bacteria
and, 178–79
Survival
stripe rust of wheat and
barley in North America
and, 78, 85–87
Sustainable agriculture
multiline cultivars and
cultivar mixtures, 373
Symbiosis
comparative genomic
analysis of
plant-associated bacteria
and, 166–83
evolutionary ecology of
plant diseases in natural
ecosystems and, 12–31
Synchytrium decipiens
evolutionary ecology of
plant diseases in natural
ecosystems and, 31
Syncytium
gene expression in
nematode feeding sites
and, 187–206
Synergy
risk assessment of
virus-resistant transgenic

plants and, 464
Systemic infections
evolutionary ecology of plant diseases in natural ecosystems and, 16
Systemic virus movement
tobacco mosaic virus assembly and disassembly, 280, 292

T

Tagetes spp.
phytochemical-based strategies for nematode control and, 218–21, 225
Take-all decline
history of research, 1, 9
specific soil suppressiveness and, 302, 310–15
Tapesia yallundae
durable resistance and, 356
Taverniera abyssinica
phytochemical-based strategies for nematode control and, 229
T-DNA
virus vectors and agriculture, 51–52
Temperate forests
evolutionary ecology of plant diseases in natural ecosystems and, 25–26
Temperature-gradient gel electrophoresis (TGGE)
specific soil suppressiveness and, 320
Temporal scale
durable resistance and, 350
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
Terminal restriction fragments (TRFs)
specific soil suppressiveness and, 319–21
Terminator-type strategies
risk assessment of virus-resistant transgenic plants and, 468
Terpenoids
phytochemical-based strategies for nematode control and, 216, 224–25
Tetracycline
antibiotic use in plant agriculture and, 434, 436, 443–44
Tetragastris panamensis
evolutionary ecology of plant diseases in natural ecosystems and, 25
Thalassia testudinum
evolutionary ecology of plant diseases in natural ecosystems and, 16
Therapeutic proteins
virus vectors and agriculture, 43, 47–49
Thielaviopsis basicola
specific soil suppressiveness and, 303
Thigomotropism
Phytophthora-host recognition and, 141–42
Tilletia spp.
durable resistance and, 358
history of research, 1, 7–8, 10
Tissue specificity
risk assessment of virus-resistant transgenic plants and, 461–62
Tn*5393*
antibiotic use in plant agriculture and, 434, 441–42
Tobacco etch virus
risk assessment of virus-resistant transgenic plants and, 460
virus vectors and agriculture, 45, 48, 53, 56, 64
Tobacco mosaic virus
assembly and disassembly
assembly, 282–83
chlorosis, 289–90
coat protein, 281–86
conclusions, 295–96
cross-protection, 293–95
disassembly, 283–86
future research, 295–96
host responses, 286–92
introduction, 280–81
necrosis, 290–91
pathogenicity, 289
resistance, 286–89
structure, 281–82
systemic movement, 292
risk assessment of virus-resistant transgenic plants and, 458, 462
virus vectors and agriculture, 45, 47–64
Tobacco rattle virus
virus vectors and agriculture, 45, 52
Tobacco ringspot virus
risk assessment of virus-resistant transgenic plants and, 460
Tobacco vein clearing virus
viral sequences integrated into plant genomes and, 117, 125–28
Tobamovirus
virus vectors and agriculture, 46
Tobravirus
virus vectors and agriculture, 46
Tolypocladium inflatum
phytochemical-based strategies for nematode control and, 232
Tomato
Phytophthora-host

recognition and, 152
Tomato aspermy virus
risk assessment of virus-resistant transgenic plants and, 470
Tomato bushy stunt virus
risk assessment of virus-resistant transgenic plants and, 470
virus vectors and agriculture, 45, 50
Tomato mosaic virus
virus vectors and agriculture, 45
Tomato spotted wilt virus
risk assessment of virus-resistant transgenic plants and, 460
virus vectors and agriculture, 48
Tombusvirus
virus vectors and agriculture, 46
Toxins
comparative genomic analysis of plant-associated bacteria and, 177–78
host-selective toxins and avirulence determinants, 245–65
Transferable suppression
specific soil suppressiveness and, 304
Transgenes
risk assessment of virus-resistant transgenic plants and, 457–74
virus vectors and agriculture, 43, 51–52
Transposons
antibiotic use in plant agriculture and, 441–42
Tree-fruit crops
antibiotic use in plant agriculture and, 437–39
T-RFLPs
specific soil suppressiveness and, 320–21
Trichilia spp.
evolutionary ecology of plant diseases in natural ecosystems and, 29
Trichinella spiralis
gene expression in nematode feeding sites and, 204
Trichoderma spp.
biological control of postharvest diseases of fruits and, 415
phytochemical-based strategies for nematode control and, 232
Trichothecium roseum
phytochemical-based strategies for nematode control and, 233
Trientalis europaea
evolutionary ecology of plant diseases in natural ecosystems and, 16
Trifolium repens
gene expression in nematode feeding sites and, 194
Triterpenoids
phytochemical-based strategies for nematode control and, 216, 226–27
Triticum spp.
multiline cultivars and cultivar mixtures, 374
stripe rust of wheat and barley in North America and, 80, 85
Trojan gene hypothesis
risk assessment of virus-resistant transgenic plants and, 468
Tropical forests
evolutionary ecology of plant diseases in natural ecosystems and, 24–25
Tsuga spp.
evolutionary ecology of plant diseases in natural ecosystems and, 23
T-toxin
host-selective toxins and avirulence determinants, 252–53
Turbatrix aceti
phytochemical-based strategies for nematode control and, 233
Turnip mosaic virus
risk assessment of virus-resistant transgenic plants and, 468
Tylenchulus semipenetrans
phytochemical-based strategies for nematode control and, 218

U

United States
stripe rust of wheat and barley in North America and, 73–107
Upregulation
gene expression in nematode feeding sites and, 195–97
Uredo glumarum
stripe rust of wheat and barley in North America and, 74
Urocystis trientalis
evolutionary ecology of plant diseases in natural ecosystems and, 16
Uromyces spp.
evolutionary ecology of plant diseases in natural ecosystems and, 30
multiline cultivars and cultivar mixtures, 378
USDA
stripe rust of wheat and

barley in North America and, 81, 88, 101
virus vectors and agriculture, 62–64
Ustilago spp.
durable resistance and, 347, 358

V

Vaccines
virus vectors and agriculture, 43, 49–51
Vaccinium angustifolium
evolutionary ecology of plant diseases in natural ecosystems and, 14
Valeriana salina
evolutionary ecology of plant diseases in natural ecosystems and, 30
Ventura inequalis
durable resistance and, 358
multiline cultivars and cultivar mixtures, 382
Verticillium chlamydosporium
phytochemical-based strategies for nematode control and, 233
Verticillium wilt
history of research, 1, 4
Vibrio sp. CH-291
Phytophthora-host recognition and, 151
Viburnum furcatum
phytochemical-based strategies for nematode control and, 228
Vicia faba
Phytophthora-host recognition and, 144
Victorin
host-selective toxins and avirulence determinants, 248–51
Viral sequences
integrated into plant genomes
activation of integrants, 131
banana streak virus, 123–25
biosafety, 131–32
conclusions, 129
DNA viruses, 118–23
introduction, 117–18
maintenance of integrants, 130–31
mechanism of integration, 129–30
nonactivated integrated sequences, 129
petunia vein clearing virus, 128
retrotransposons, 118–23
tobacco vein clearing virus, 125–28
virB operon
comparative genomic analysis of plant-associated bacteria and, 176
Virology
evolutionary ecology of plant diseases in natural ecosystems and, 20
gene expression in nematode feeding sites and, 198
multiline cultivars and cultivar mixtures, 383–84
tobacco mosaic virus assembly and disassembly, 280–96
Virulence
durable resistance and, 342–65
host-selective toxins and avirulence determinants, 245–65
stripe rust of wheat and barley in North America and, 90, 93–97
Virus movement
risk assessment of virus-resistant transgenic plants and, 461–62
Virus-resistant transgenic plants (VRTPs)
CaMV 35S promoter, 471–72
complementation, 461–64
decision making, 473–74
genotypic effects, 464–71
heterologous encapsidation, 461–64
host range, 461–62
introduction, 457–61
mutational drift in CMV satellite RNA, 464–65
phenotypic effects, 461–64
recombination, 469–71
resistance breakdown, 472–73
synergy, 464
tissue specificity, 461–62
virus movement, 461–62
virus transmission, 462–63
wild plants due to plant-to-plant gene flow, 465–71
Virus vectors
new agriculture and agronomic approaches, 57–58
biological containment and safety, 62–64
commercial-based opportunities for plant virus-based systems, 47–53
conclusions, 64–65
development of plant viruses as expresssion vectors, 45–47
field application of virus expression vectors, 55
functional production

vector properties, 53–64
gene function discovery, 51–53
introduction, 43–47
optimal properties of production hosts, 55–57
recombinant protein bioreactors, 44
recombinant protein extraction, 58–61
recombinant proteins in medicine, 43–44
release testing, 61–62
therapeutic proteins, 47–49
vaccines, 49–51
vector scale up and production, 53–55

W

Wheat
durable resistance and, 361
stripe rust of in North America, 73–107
Wheat streak mosaic virus
virus vectors and agriculture, 45
Wild plants
evolutionary ecology of plant diseases in natural ecosystems and, 12–31
risk assessment of virus-resistant transgenic plants and, 465–71
Wilts
evolutionary ecology of plant diseases in natural ecosystems and, 17
Winter survival
stripe rust of wheat and barley in North America and, 85–87
Wound responses
gene expression in nematode feeding sites and, 189, 190–94

X

Xanthomonas axonopodis pv *citri*
comparative genomic analysis of plant-associated bacteria and, 166–83
Xanthomonas campestris
antibiotic use in plant agriculture and, 434, 442–43
comparative genomic analysis of plant-associated bacteria and, 166–83
durable resistance and, 354, 358–59
multiline cultivars and cultivar mixtures, 380
Xanthomonas oryzae pv. *oryzae*
durable resistance and, 354, 358–59
multiline cultivars and cultivar mixtures, 380
Xiphinema americanum
phytochemical-based strategies for nematode control and, 221
Xylella fastidiosa
comparative genomic analysis of plant-associated bacteria and, 166–83

Y

Yeast
biological control of postharvest diseases of fruits and, 410–11, 414–16, 418–19, 421
comparative genomic analysis of plant-associated bacteria and, 176
Phytophthora-host recognition and, 153
risk assessment of virus-resistant transgenic plants and, 459
Yersinia pestis
comparative genomic analysis of plant-associated bacteria and, 179
Yr genes
stripe rust of wheat and barley in North America and, 96–97, 102, 104

Z

Zea mays
multiline cultivars and cultivar mixtures, 384
Zoospore chemotaxis
Phytophthora-host recognition and, 137–39
Zostera marina
evolutionary ecology of plant diseases in natural ecosystems and, 16
Zucchini yellow mosaic virus
risk assessment of virus-resistant transgenic plants and, 462
virus vectors and agriculture, 45, 48, 53, 64